

**Standard** ECMA-356

2<sup>nd</sup> Edition / June 2013

**NFCIP-1 - RF Interface  
Test Methods**

**Standard**



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## **Introduction**

Ecma International purposefully aligned this Standard with ISO/IEC 10373-6 to allow testing laboratories to reuse equipment and expertise.

This 2nd edition is fully aligned with the 2nd edition of ISO/IEC 22536:2013.

This Ecma Standard has been adopted by the General Assembly of June 2013.

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# NFCIP-1 - RF Interface Test Methods

## 1 Scope

This Standard is part of a suite of standards that specify tests for ECMA-340 (ISO/IEC 18092). It defines test methods for the RF-interface. This Standard specifies RF-test methods for NFCIP-1 devices with antennas fitting within the rectangular area of 50 mm by 40 mm.

This test standard, the first of two parts, specifies compliance tests for the RF interface of ECMA-340 devices. The companion test standard ECMA-362 (ISO/IEC 23917) specifies protocol tests for ECMA-340.

## 2 Conformance

A system implementing ECMA-340 is in conformance with this Standard if it meets all the mandatory requirements specified herein.

## 3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ECMA-340, *Near Field Communication - Interface and Protocol (NFCIP-1) (ISO/IEC 18092)*

ISO/IEC 10373-6:2011, *Identification cards — Test methods — Part 6: Proximity cards*

## 4 Conventions and notations

### 4.1 Representation of numbers

The following conventions and notations apply in this document unless otherwise stated.

- Letters and digits in single quotes represent numbers in hexadecimal notation.
- The value of a bit is denoted by (0)b or (1)b.
- Bit patterns are represented by strings of digits 0 and 1 shown with the most significant bit to the left within parentheses. Within such strings, X may be used to indicate that the value of a bit is not specified within the string.

### 4.2 Names

The names of basic elements, e.g. specific fields, are written with a capital initial letter.

### 4.3 Test report

The test report includes the number of passed tests versus the total number of tests, the number of different samples and the date of the tests, see Annex A.

## 5 Abbreviations and acronyms

In addition to the abbreviations and acronyms in ECMA-340, the following apply.

DFT	Discrete Fourier Transformation
DUT	Device Under Test
fc	Frequency of the operating field
fs	Frequency of subcarrier at 106 kbit/s in passive communication mode
$H_m$	Maximum external field strength for not preventing the Initiator to switch on its RF field
$H_{max}$	Maximum field strength of the Initiator antenna field
$H_{min}$	Minimum field strength of the Initiator antenna field
$H_{Threshold}$	Minimum field strength for the RF level detector
PCB	Printed Circuit Board
RF	Radio Frequency

## 6 Default items applicable to the test methods

### 6.1 Test environment

See 4.1 of ISO/IEC 10373-6.

### 6.2 Default tolerance

See 4.3 of ISO/IEC 10373-6.

### 6.3 Spurious Inductance

See 4.4 of ISO/IEC 10373-6.

### 6.4 Total measurement uncertainty

See 4.5 of ISO/IEC 10373-6.

### 6.5 Antenna class

Tests shall be executed for class 3 antenna as specified in ISO/IEC 10373-6:2010/Amd.1.

NOTE When the antenna size used for NFCIP-1 device is larger than "Class 3" antenna, "Class 1" antenna as specified in ISO/IEC 10373-6:2011/Amd.1 may be used in addition to "Class 3" antenna.

## 7 Test Set-up and test circuits

The test set-up includes:

- Digital sampling oscilloscope;
- Calibration coil;
- Test assembly;



— Reference Device.

These are described in the following clauses.

### **7.1 Digital sampling oscilloscope**

See ISO/IEC 10373-6, 5.1.1.

### **7.2 Calibration coil**

See ISO/IEC 10373-6, 5.2.

### **7.3 Test assembly**

See ISO/IEC 10373-6, 5.3.

### **7.4 Reference Device**

The Reference Device is used to test the ability of an Initiator to:

- generate a field strength of at least  $H_{\min}$  and not exceeding  $H_{\max}$ ;
  - transmit a modulated signal to a Target;
  - receive a load modulation signal from the Target in passive communication mode
- in its operating volume.

The Reference Device is used to test the ability of a Target to:

- generate a field strength of at least  $H_{\min}$  and not exceeding  $H_{\max}$  in active communication mode;
  - transmit a modulated signal to an Initiator
- in its operating volume.

#### **7.4.1 Dimensions of the Reference Device**

See ISO/IEC 10373-6, 5.4.1.

#### **7.4.2 Reference Device construction**

See ISO/IEC 10373-6, 5.4.2. The Reference Device coils layouts shall be as defined in ISO/IEC 10373-6:2010 Amd.1, Annex D.3.

NOTE When the antenna larger than “Class 3”, the Reference Device 1 coils as defined in ISO/IEC 10373-6:2011/ Amd.1 Annex D.1 may be used in addition to the Reference Device 3.

#### **7.4.3 Reference Device resonance frequency tuning**

See ISO/IEC 10373-6, 5.4.3.

## 8 Functional Test – Initiator

### 8.1 Initiator RF field detection

#### 8.1.1 Purpose

The purpose of this test is to verify that the Initiator detects an external RF field with a field strength higher than  $H_{\text{Threshold}}$  as specified in 8.4 of ECMA-340.

#### 8.1.2 Test procedure

The test assembly as specified in 7.3 is used.

##### Step 1:

The RF power delivered by the signal generator to the Test PCD antenna shall be adjusted to the required field strength in the range of 0 up to  $H_{\text{max}}$  as measured by the calibration coil without any NFCIP-1 device.

The output of the test circuit is connected to a digital sampling oscilloscope. The potentiometer P1 shall be trimmed to minimize the residual carrier. This signal shall be at least 40 dB lower than the signal obtained by shorting one sense coil so that it can be used to detect if the DUT switches on the RF field.

##### Step 2:

The NFCIP-1 device under test shall be placed in the DUT position, concentric with sense coil a. The DUT shall be set into Initiator mode.

The signal generator shall start to generate a non-modulated RF-field at the frequency  $f_c$ . The field strength shall be increased linearly in the range from 0 up to maximum field strength  $H_m$  which can be applied, not preventing the Initiator to switch on its RF field.

The test shall verify if the Initiator correctly handles its RF-field:

The DUT passes this test if  $H_m$  is below  $H_{\text{Threshold}}$ .

#### 8.1.3 Test report

The test report shall indicate whether the Initiator behaves correctly according to the procedure described in 8.1.2.

### 8.2 Initiator field strength in active and passive communication mode

#### 8.2.1 Purpose

The purpose of this test is to verify that the field strength produced by an Initiator in its operating volume as specified in 8.2 of ECMA-340.

#### 8.2.2 Test procedure

See ISO/IEC 10373-6, 7.1.1.2.

#### 8.2.3 Test report

See ISO/IEC 10373-6, 7.1.1.3.

### **8.3 Initiator modulation index and waveform transmission in active and passive communication mode**

#### **8.3.1 Purpose**

The purpose of this test is to verify that the modulation index of the Initiator field as well as the rise and fall times and the overshoot values for all bit rates are as specified in 9.2.1.2 and 9.2.2.2 of ECMA-340 within the defined operating volume.

#### **8.3.2 Test procedure**

See ISO/IEC 10373-6, 7.1.4.2.

#### **8.3.3 Test report**

The test report shall give the measured modulation index of the Initiator field, the rise and fall times and overshoot values, within the defined operating volume in unloaded and loaded conditions.

### **8.4 Initiator load modulation reception in passive communication mode**

#### **8.4.1 Purpose**

The purpose of this test is to verify that the Initiator detects the load modulation of a Target as specified in 9.3.2.2 and 9.3.3.2 of ECMA-340.

#### **8.4.2 Test procedure**

See ISO/IEC 10373-6, 7.1.5.2.

#### **8.4.3 Test report**

The test report shall give the Initiator load modulation for the tested positions.

### **8.5 Initiator modulation index and waveform reception in active communication mode**

#### **8.5.1 Purpose**

The purpose of this test is used to verify that the Initiator detects the modulation waveforms of a Target in active communication mode as specified in 9.2.1.2 and 9.2.2.2 of ECMA-340.

#### **8.5.2 Bit rate of 106 kbit/s**

##### **8.5.2.1 Test condition**

See ISO/IEC 10373-6, 7.2.2.2.1.

##### **8.5.2.2 Test procedure**

The test assembly as defined in 7.3 is used.

Under the conditions defined in 8.5.2.1 the Initiator shall detect the modulation waveform sent by the test assembly and continue normal operation.

### **8.5.2.3 Test report**

The test report shall confirm the intended operation of the Initiator. Used test conditions shall be mentioned in the test report.

## **8.5.3 Bit rates of 212 kbit/s and 424 kbit/s**

### **8.5.3.1 Test condition**

See ISO/IEC 10373-6 7.2.2.3.1.

### **8.5.3.2 Test procedure**

The test assembly as defined in 7.3 is used.

Under the conditions defined in 8.5.3.1 the Initiator shall detect the modulation waveform sent by the test assembly and continue normal operation.

### **8.5.3.3 Test report**

The test report shall confirm the intended operation of the Initiator. Used test conditions shall be mentioned in the test report.

## **8.6 Initiator maximum loading effect test in active communication mode (Optional)**

### **8.6.1 Purpose**

The purpose of this test is to understand that the loading effect of the Initiator during reception in active communication mode is whether less or more than that of the Reference Device.

### **8.6.2 Test procedure**

As defined for the Class 3 PICC in ISO/IEC 10373-6:2010/Amd.1, 7.2.4.2 and a DC voltage at CON3 of 4,5 V.

### **8.6.3 Test report**

See ISO/IEC 10373-6, 7.2.4.3.

## **9 Functional Test – Target**

### **9.1 Target load modulation transmission in passive communication mode**

#### **9.1.1 Purpose**

The purpose of these tests is to verify that the amplitude of the Target's load modulation signal is as specified in 9.3.2.2 and 9.3.3.2 of ECMA-340.

#### **9.1.2 Test procedure**

ECMA-340 specifies 3 different bit rates for the passive communication mode. The test for the Target in the passive communication mode shall be performed at 106 kbit/s, 212 kbit/s and 424 kbit/s.

#### **9.1.2.1 Test procedure for 106 kbit/s**

As defined for the PICC in ISO/IEC 10373-6, 7.2.1.2.

#### **9.1.2.2 Test report at 106 kbit/s**

If the amplitudes of the upper sideband  $fc+fs$  and the lower sideband  $fc-fs$  respectively are above the values specified in ECMA-340 then this test passes.

#### **9.1.2.3 Test procedure for 212 kbit/s and 424 kbit/s**

As specified for the PICC in ISO/IEC 10373-6, 7.2.1.2, but replace “subcarrier” by “carrier”.

A REQA or REQB command sequence shall be replaced by a Polling Request command specified in ECMA-340, and a signal or load modulation response shall be replaced by a Polling Response command specified in ECMA-340.

#### **9.1.2.4 Test report at 212 kbit/s and 424 kbit/s**

If the amplitudes of the modulated data are above the values specified in ECMA-340 then this test passes.

### **9.2 Target field strength in active communication mode**

Execute 8.2 for Target.

### **9.3 Target modulation index and waveform transmission in active communication mode**

Execute 8.3 for Target.

### **9.4 Target modulation index and waveform reception in active and passive communication mode**

Execute 8.5 by exchanging Target and Initiator.

### **9.5 Target maximum loading effect test in Passive communication mode (Optional)**

See 8.6 for Target.



## Annex A (informative)

### Test report template example

Supplier:

Product:

Legend:

# passed tests = number tests that have been successfully performed

# tests = total number of performed tests

# samples = number of different DUTs

# of tested positions = number of different positions in the operating volume

No	Testname		Purpose			
8.1	Initiator RF Level Detection		The purpose of this test is to verify that the Initiator detects an external RF field with a field strength higher than $H_{\text{Threshold}}$ as specified in 8.4 of ECMA-340.			
	Conditions	Expected Result according ECMA-340	# passed tests	# tests	# samples	Date
	$H < H_{\text{Threshold}}$	DUT switches its RF field on				
	$H_{\text{Threshold}} = < H < H_{\text{max}}$	DUT does not switch its RF field on				
No	Testname		Purpose			
8.2	Initiator field strength in active and passive communication mode.		The purpose of this test is to verify that the field strength produced by an Initiator in its operating volume as specified in 8.2 of ECMA-340.			
	Conditions	Expected Result according ECMA-340	# passed tests	# tests & # of tested positions	# samples	Date
	Different positions in the operating volume	$H_{\text{min}} \leq H \leq H_{\text{max}}$				

No	Testname	Purpose				
8.3	Initiator modulation index and waveform transmission in active and passive communication mode.	The purpose of this test is to verify that the modulation index of the Initiator field as well as the rise and fall times and the overshoot values for all bit rates are as specified in 9.2.1.2 and 9.2.2.2 of ECMA-340 within the defined operating volume.				
	<b>Conditions</b>	<b>Expected Result according ECMA-340</b>	<b># passed tests</b>	<b># tests &amp; # of tested positions</b>	<b># samples</b>	<b>Date</b>
	Different positions in the operating volume	Waveform parameters within requirements as defined in ECMA-340.				
No	Testname	Purpose				
8.4	Initiator load modulation reception in passive communication mode	The purpose of this test is to verify that the Initiator detects the load modulation of a Target as specified in 9.3.2.2 and 9.3.3.2 of ECMA-340.				
	<b>Conditions</b>	<b>Expected Result according ECMA-340</b>	<b># passed tests</b>	<b># tests &amp; # of tested positions</b>	<b># samples</b>	<b>Date</b>
	Different positions in the operating volume  106 kbit/s, 212 kbit/s, 424 kbit/s	Load modulation amplitude sensitivity below requirements as defined in ECMA-340.				



No	Testname		Purpose			
8.5	Initiator modulation index and waveform reception in active communication mode.		The purpose of this test is used to verify that the Initiator detects the modulation waveforms of a Target in active communication mode as specified in 9.2.1.2 and 9.2.2.2 of ECMA-340.			
	Conditions	Expected Result according ECMA-340	# passed tests	# tests	# samples	Date
	$H_{min}$ , $H_{max}$ 106 kbit/s	If the Initiator correctly detects the applied modulation waveforms and continues normal operation then this test passes.				
	$H_{min}$ , $H_{max}$ 212 kbit/s	If the Initiator correctly detects the applied modulation waveforms and continues normal operation then this test passes.				
	$H_{min}$ , $H_{max}$ 424 kbit/s	If the Initiator correctly detects the applied modulation waveforms and continues normal operation then this test passes.				
No	Testname		Purpose			
8.6	Initiator maximum loading effect test in active communication mode (Optional)		The purpose of this test is to verify that the loading effect of the Initiator during reception in active communication mode is less than that of the Reference Device.			
	Conditions	Expected Result	# passed tests	# tests & # of tested positions	# samples	Date
	$H_{min}$	Loading effect less than that of Reference Device.				

No	Testname		Purpose			
9.1	Target load modulation transmission in passive communication mode		The purpose of these tests is to verify that the amplitude of the Target's load modulation signal is as specified in 9.3.2.2 and 9.3.3.2 of ECMA-340.			
	Condition	Expected Result according ECMA-340	# passed tests	# tests	# samples	Date
	106 kbit/s	If the amplitudes of the upper sideband $fc+fs$ and the lower sideband $fc-fs$ respectively are above the values specified in ECMA-340 then this test passes.				
	212 kbit/s	If the amplitudes of the modulated data are above the values specified in ECMA-340 then this test passes.				
	424 kbit/s	If the amplitudes of the modulated data are above the values specified in ECMA-340 then this test passes.				
No	Testname		Purpose			
9.2	Target field strength in active communication mode.		The purpose of this test is to verify that the field strength produced by a Target in its operating volume as specified in 8.2 of ECMA-340.			
	Conditions	Expected Result according ECMA-340	# passed tests	# tests & # of tested positions	# samples	Date
	Different positions in the operating volume	$H_{\min} \leq H \leq H_{\max}$				

No	Testname	Purpose				
9.3	Target modulation index and waveform transmission in active communication mode.	The purpose of this test is to verify that the modulation index of the Target field as well as the rise and fall times and the overshoot values for all bit rates are as specified in 9.2.1.2 and 9.2.2.2 of ECMA-340 within the defined operating volume.				
	<b>Conditions</b>	<b>Expected Result according ECMA-340</b>	<b># passed tests</b>	<b># tests &amp; # of tested positions</b>	<b># samples</b>	<b>Date</b>
	Different positions in the operating volume	Waveform parameters within requirements as defined in ECMA-340.				
No	Testname	Purpose				
9.4	Target modulation index and waveform reception in active and passive communication mode.	The purpose of this test is used to verify that the Target detects the modulation waveforms of an Initiator in active communication mode as specified in 9.2.1.2 and 9.2.2.2 of ECMA-340.				
	<b>Conditions</b>	<b>Expected Result according ECMA-340</b>	<b># passed tests</b>	<b># tests</b>	<b># samples</b>	<b>Date</b>
	$H_{min}$ , $H_{max}$ 106 kbit/s	If the Target correctly detects the applied modulation waveforms and continues normal operation then this test passes.				
	$H_{min}$ , $H_{max}$ 212 kbit/s	If the Target correctly detects the applied modulation waveforms and continues normal operation then this test passes.				
	$H_{min}$ , $H_{max}$ 424 kbit/s	If the Target correctly detects the applied modulation waveforms and continues normal operation then this test passes.				
No	Testname	Purpose				
9.5	Target maximum loading effect test in passive communication mode (Optional)	The purpose of this test is to verify that the loading effect of the Target during reception in passive communication mode is less than that of the Reference Device.				
	<b>Conditions</b>	<b>Expected Result</b>	<b># passed tests</b>	<b># tests &amp; # of tested positions</b>	<b># samples</b>	<b>Date</b>
	$H_{min}$	Loading effect less than that of Reference Device.				

